General

Guideline Title

ACR Appropriateness Criteria® hematuria — child.

Bibliographic Source(s)

Dillman JR, Coley BD, Karmazyn B, Binkovitz LA, Dempsey ME, Dory CE, Garber M, Hayes LL, Meyer JS, Milla SS, Paidas C, Raske ME, Rigsby CK, Strouse PJ, Wootton-Gorges SL, Expert Panel on Pediatric Imaging. ACR Appropriateness CriteriaÂ® hematuria -- child. [online publication]. Reston (VA): American College of Radiology (ACR); 2012. 9 p. [79 references]

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Coley BD, Gunderman R, Bulas D, Fordham L, Meyer JS, Karmazyn BK, Podberesky DJ, Prince JS, Paidas C, Rodriguez W, Expert Panel on Pediatric Imaging. ACR Appropriateness Criteria® hematuria - child. [online publication]. Reston (VA): American College of Radiology (ACR); 2009. 7 p.

Recommendations

Major Recommendations

ACR Appropriateness Criteria®

Clinical Condition: Hematuria – Child

Variant 1: Isolated hematuria (nonpainful, nontraumatic).

Radiologic Procedure	Rating	Comments	RRL*
US kidneys and bladder	7	Most useful if isolated gross hematuria or persistent unexplained isolated microscopic hematuria is present.	O
X-ray voiding cystourethrography	3	May be useful if abnormality found on US.	
CT abdomen and pelvis without contrast	1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		*Relative Radiation Level

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis with contrast	3		
MRI abdomen and pelvis without and with contrast	3		O
CT abdomen and pelvis without and with contrast	2		
X-ray abdomen and pelvis	2		
MRI abdomen and pelvis without contrast	2		O
Arteriography kidneys	2		
X-ray intravenous urography	2		
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 2: Painful hematuria (nontraumatic).

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis without contrast	8	To evaluate for stones. CT and US are alternative examinations. If US findings are negative, CT may be clinically indicated in some cases. May also detect other causes of painful hematuria, such as UPJ obstruction or renal tumor.	
US kidneys and bladder	8	CT and US are alternative examinations.	O
X-ray abdomen and pelvis	6		
MRI abdomen and pelvis without and with contrast	3		O
CT abdomen and pelvis with contrast	3		
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Radiologic Procedure	Rating	Comments	RRL*
X-ray intravenous urography	2		
X-ray voiding cystourethrography	2		
MRI abdomen and pelvis without contrast	2		O
Arteriography kidneys	2		
CT abdomen and pelvis without and with contrast	2		
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 3: Traumatic hematuria – macroscopic.

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis with contrast	9	If perinephric fluid is present on initial scanning, delayed imaging may be indicated to further assess for urinary tract injury.	
X-ray retrograde urethrography	6	If blood is present at urethral meatus, or if there are periureteral pelvic fractures.	
CT pelvis with bladder contrast (CT cystography)	5	If bladder injury or pelvic fractures are suspected. Active bladder distention is preferred to passive distension to demonstrate leaks.	
Arteriography kidneys	3	May be appropriate for interventional therapy.	
US kidneys and bladder	3	May be useful for follow-up after initial CT characterization of injuries.	O
X-ray abdomen and pelvis	2		

Radiologic Procedure	Rating	Comments	RRL*
X-ray intravenous urography	2		
CT abdomen and pelvis without and with contrast	2		
CT abdomen and pelvis without contrast	2		
MRI abdomen and pelvis without contrast	2		O
MRI abdomen and pelvis without and with contrast	2		O
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 4: Traumatic hematuria – microscopic.

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis with contrast	7	CT may be indicated in the presence of risk factors such as pelvic fractures, lower rib fractures, flank pain and tenderness, hypotension, or other abdominopelvic injuries. If perinephric fluid is present on initial scanning, delayed imaging may be indicated to further assess for renal vascular or urinary tract injury.	
US kidneys and bladder	4	US can exclude underlying mass or congenital anomaly.	O
Arteriography kidneys	2		
X-ray abdomen and pelvis	2		
X-ray voiding cystourethrography	2		
X-ray intravenous urography	2		
CT abdomen and pelvis without and with contrast	2		
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis without contrast	2		
MRI abdomen and pelvis without contrast	2		O
MRI abdomen and pelvis without and with contrast	2		O
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Summary of Literature Review

Hematuria is the presence of red blood cells in the urine, either visible to the eye (macroscopic hematuria) or as viewed under the microscope (microscopic hematuria). Detecting blood in the urine of a child may cause alarm to patients, parents, and physicians.

The clinical evaluation of children with any form of hematuria begins with a meticulous history. Topics covered in the history commonly include urinary tract infection, strenuous exertion, tropical exposure, recent strep throat, recent trauma, menstruation, bleeding tendency, bloody diarrhea, joint pains, rash, flank pain, frequency, and dysuria. Searching for occult forms of trauma, foreign body insertion, family history of sickle cell disease or hemophilia, stone disease, hearing loss, familial renal disease, and hypertension should be undertaken. Factitious causes of "hematuria," such as food substances or medicines coloring the urine without actually having red blood cells in the urine, should also be investigated. An assessment of the child's height and weight should be followed by a thorough physical examination. Fevers, arthritis, rashes, soft-tissue edema, nephromegaly, abdominal masses, genital or anal bleeding suggesting sexual abuse, deafness, and costovertebral angle tenderness should be discerned.

The next step is a thorough evaluation of the urine. Tea-colored urine and hematuria accompanied by proteinuria (>2+ by dip stick), red blood cell casts, and deformed red blood cells (best seen with phase contrast microscopy) suggest a glomerular source of hematuria (e.g., glomerulonephritis). As will be discussed, imaging may not be required for glomerular sources of bleeding, whereas it may be useful in nonglomerular sources of hematuria. The presence of white cells and microorganisms within the urine clearly indicate the possibility of a urinary tract infection, which will direct care and imaging by a different set of criteria. Evaluation for hypercalciuria (such as a spot urine calcium/creatinine ratio) and a urine culture may be indicated. Basic laboratory metabolic screening will indicate findings of chronic kidney disease or long-standing acidosis, when present; initial evaluation should include a blood urea nitrogen (BUN) test, a serum creatinine test, complete blood count, and a platelet count. If suggested by the initial clinical workup, more advanced medical assessment for various causes of glomerulonephritis and vasculitis should be performed, and an audiogram should be performed if indicated.

The need for imaging evaluation depends on the clinical scenario in which hematuria presents. This review focuses on the following clinical variations of childhood hematuria:

- Isolated hematuria
- Painful hematuria
- Renal trauma with gross hematuria
- Renal trauma with microscopic hematuria

The literature on pediatric hematuria generally consists of cohort studies (most being retrospective), as well as literature reviews and reports of personal experience. There are few randomized controlled trials or comparison studies. Despite these limitations, however, there are good and reasonably consistent data in the more recent literature to provide guidance on whether and how to image children with hematuria.

When the child has a definite medical diagnosis suggested by clinical evaluation (such as postinfectious glomerulonephritis, Henoch-Schönlein purpura, coagulopathy, sickle cell disease, systemic lupus erythematosus, or infection), imaging may be necessary to assess the size of the kidneys

as an indicator of the chronicity of the renal disease and also as an assessment before renal biopsy. In this situation, ultrasound (US) is the best modality to display the anatomy, size, and position of the kidneys (especially prior to biopsy) and to screen for other pre-existing structural lesions. If the US findings are normal, renal biopsy can sometimes add to the diagnosis of the common renal parenchymal diseases causing hematuria, such as immunoglobulin A (IgA) nephropathy (Berger's disease) or Alport's syndrome. However, many patients are followed clinically at this point without more extensive workup.

Isolated Hematuria (nonpainful, nontraumatic)

Asymptomatic microscopic hematuria (usually defined as five or more red blood cells per high-powered field on at least two of three consecutive urine specimens) is a common entity, with an incidence estimated to be 0.25% to 1.0% in children 6 to 15 years of age. Patients without proteinuria or dysmorphic red blood cells (which indicate glomerular disease) are unlikely to have clinically significant renal disease, and there is good evidence that no imaging is indicated. One study evaluated 325 patients with microscopic hematuria; 87% had renal US and 24% had voiding cystoscopy urethrograms (VCUGs), and no findings were deemed to be clinically significant. As with asymptomatic isolated gross hematuria, intravenous urography (IVU) is not indicated in evaluating asymptomatic isolated microscopic hematuria.

Microscopic hematuria is sometimes associated with hypercalciuria and/or hyperuricosuria, and some authors advocate renal US to evaluate for renal calculi in these patients, although others have found little value in this technique. In cases of persistent unexplained microhematuria, US may be useful to evaluate for occult anatomic abnormalities (cystic renal disease, vascular abnormalities, congenital malformations, etc.), although the yield of these examinations is likely low. Screening family members' urine may also be useful in the setting of persistent unexplained microhematuria, as benign familial hematuria, including thin basement membrane nephropathy, has been described. Thin basement membrane nephropathy has been reported to be the most common cause of asymptomatic hematuria and usually has a benign course. When nonmedical pressures (e.g., parental anxiety over neoplasia) are an issue, US is the modality of choice due to its relatively lower cost and lack of patient risk, and in some cases it may be justified for the reassurance it provides. However, it must be recognized that isolated microscopic hematuria is very rarely the presenting scenario of Wilms tumor.

While isolated asymptomatic gross hematuria is usually due to benign and self-limited processes, there is fair to good evidence supporting the performance of US on these patients. Cystoscopy is rarely indicated in the workup of a child with gross hematuria, whereas adults would routinely have cystoscopy performed to evaluate for urothelial carcinoma of the bladder. The child's urinary bladder will be examined during the renal US to assess for the presence of bladder lesions not diagnosed by the medical workup, such as polyps, masses, or vascular lesions. The bladder should be distended with urine in order to optimize sonographic assessment. However, if unexplained hematuria persists and there is concern for bladder urothelial neoplasm, cystoscopy may be indicated. A VCUG should be considered to evaluate for vesicoureteral reflux, posterior urethral valves in the male, or other urethral causes of hematuria such as polyps, meatal stenosis, Cowper's duct cyst, urethral stenosis, or an abnormality of the fossa navicularis. Renal and bladder tumors may present with gross hematuria and are likely to be found with US. A renal or bladder mass that is detected by US should have further imaging with computed tomography (CT) or magnetic resonance imaging (MRI) to define the local extent of disease or vascular invasion (in the case of Wilms tumor), and to detect the presence of any metastases. Since the incidence of transitional cell uroepithelial neoplasia is extremely rare in children, IVU is not indicated. While CT is an excellent modality for imaging the genitourinary tract, given its expense and radiation exposure it is not indicated as a first-line test. In the cases of a suspected vascular lesion, such as a distended left renal vein from the nutcracker phenomenon or an intrarenal vascular malformation (or fistula), US is still the best method of initial evaluation, although contrast-enhanced CT, MRI, or angiography may be necessary for further diagnosis.

Painful Hematuria

In the patient with abdominal pain and hematuria, the principal differential diagnosis is urolithiasis, although tumor and ureteropelvic junction (UPJ) obstruction should also be included. In young patients with genitourinary tract stone disease, the presenting symptoms may not be as classic as in adults, which in turn leads to uncertainty about the best imaging approach. Interestingly, a number of pediatric patients with urolithiasis do not have hematuria. While the incidence of pediatric stone disease is considerably lower than in adults, it is still commonly seen in busy pediatric practices. Affected children may have a family history of nephrolithiasis or predisposing inborn metabolic disease. While the literature provides some general suggestions and guidelines, what imaging test to perform under what clinical scenario is not universally agreed upon.

There is good evidence in the adult and pediatric imaging literature that CT is the most accurate imaging modality in the identification of stones and the quantification of stone burden. CT scanning of course exposes these children to ionizing radiation. Because with proper techniques and newer image iterative reconstruction algorithms the CT dose can be very low and lowered to less than that of a traditional IVU, it raises the question of whether other imaging modalities (specifically radiographs and US) still play a role in pediatric stone disease. In a study of 178 adult and pediatric patients, it was found that radiographs had a 59% sensitivity for stone detection. Another study reported that US found 75% of all urinary tract stones, although US found only 38% of stones within the ureter. Similarly, a third study showed that US correctly found stones in 78% of patients, although it only found 25% of ureteral stones. Another study showed variations in US stone detection between the right and left kidney, with a maximum accuracy of 77% for the right kidney and 54% for the left kidney, as compared to CT. Limitations of both radiography and US in

children include greater obscuration by bowel gas and contents, and smaller stone size than in adults, neither of which impairs CT evaluation. The addition of color Doppler evaluation for "twinkling" artifact improves renal stone detection, although a sizable percentage of renal stones detected at CT may not demonstrate "twinkling" artifact and some foci of "twinkling" artifact may not be associated with radiopaque calculi at CT. This artifact can be used to detect stones in the renal collecting system and visualized portions of the ureter, including at the ureterovesical junction. US is still recommended as a first-line screening test and, if positive, can then direct patient management, with the caveat that a negative US does not exclude stone disease. IVU is seldom indicated in children as an initial examination, although a limited study may provide information about stone position and movement after initial diagnosis.

Traumatic Hematuria

Hematuria is frequently found in the pediatric patient with blunt abdominal trauma. In children, the most commonly injured viscera are the spleen, liver, and kidney. The amount of hematuria that should trigger radiologic investigation of the urinary tract is somewhat controversial, but several facts are well accepted:

- Gross hematuria is a finding that necessitates a radiologic evaluation of the abdomen and pelvis.
- Isolated microscopic hematuria without any clinical or laboratory findings of visceral trauma does not need emergency investigation.
- The presence of blood in the urethral meatus in a patient with pelvic fractures should lead to an investigation of the urethra and bladder (50% incidence of genitourinary injury).
- Minor trauma to an anomalous kidney can cause major clinical repercussions (renal anomalies occur in 1% to 4% of the population).
- All CT scans must be done with intravenous (IV) contrast (enhanced CT), unless specifically contraindicated.
- Hypotension is an unreliable clinical indicator for prompting imaging in children.

Macroscopic Hematuria

There is good evidence from multiple adult and pediatric studies that contrast-enhanced CT scan is the best modality for evaluating renal trauma and that such imaging is required in patients with gross hematuria. While US has been advocated as a first-line imaging test in abdominal trauma, renal injuries are sometimes missed, and in the setting of gross hematuria these patients are better served with CT. While there is evidence that contrast-enhanced US may perform nearly as well as CT in detecting traumatic injuries, US contrast agents are not currently available for this use in the United States. If renal injury is detected on CT, delayed scans should be obtained to evaluate for collecting system disruption.

Patients with gross hematuria and pelvic fractures are at high risk for bladder rupture. The conventional fluoroscopic cystogram requires moving the patient to another imaging suite. There is good evidence that CT cystography is an accurate method of evaluation, with the advantage that the patient need not be moved from the CT scanner. Images may be obtained with a contrast-filled bladder and then after drainage, although one study in adults suggests that postvoid images may be unnecessary. Multiplanar reformatted images may help in diagnosis.

Patients with blood at the urethral meatus, especially if associated with pelvic fractures or straddle injuries, are at risk for urethral injury and disruption. These patients should undergo retrograde urography (RUG) prior to bladder catheter placement and may warrant a cystogram to exclude concomitant bladder injury.

The limited or "one-shot" IVU was once a mainstay of adult renal trauma imaging. In current practice in a hemodynamically stable pediatric patient, the IVU has little role in the evaluation of hematuria.

Microscopic Hematuria

Different threshold values have been used for evaluating post-traumatic microhematuria, but in general >50 red blood cells per high-powered field (RBC/hpf) has been used as a threshold for imaging. However, recent studies note at best a fair correlation between degree of microhematuria and risk or severity of renal injury, and the use of a cutoff value may not be appropriate.

For patients with isolated microscopic hematuria without co-existent injury, there is good evidence that renal imaging with CT is unlikely to disclose clinically significant findings. While there have been advocates for US in this setting, it is unlikely to provide meaningful patient management information.

However, children with microscopic hematuria can have significant renal trauma, frequently associated with co-existent injury or congenital abnormalities (e.g., UPJ obstruction), as well as associated clinical findings. There is good evidence that patients with multiorgan injury, a history of deceleration injury, localized flank pain, and ecchymosis should undergo CT imaging to evaluate for renal injury, even when gross hematuria is not present. While hypotension is an unreliable clinical indicator in the child (unlike the adult), a child with a falling hemoglobin or hemodynamic instability should be considered for imaging.

Microscopic hematuria has also been combined with other clinical variables to create prediction rules for identifying children with intra-abdominal

injuries following blunt abdominal trauma.

Summary

- Isolated nonpainful hematuria is best evaluated by US if it is gross or if it is microscopic and persistent, unexplained, and nonfamilial.
- To evaluate for renal calculi, CT without contrast is the most useful examination, although US can also be a first-line imaging test. A normal US examination does not exclude urinary tract stones. Be sure to reduce CT radiation dose if possible.
- In the setting of trauma, CT with contrast is the most useful examination, especially with macroscopic hematuria.

Abbreviations

- CT, computed tomography
- MRI, magnetic resonance imaging
- UPJ, ureteropelvic junction
- US, ultrasound

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
	<0.1 mSv	<0.03 mSv
	0.1-1 mSv	0.03-0.3 mSv
	1-10 mSv	0.3-3 mSv
	10-30 mSv	3-10 mSv
	30-100 mSv	10-30 mSv
*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."		

Clinical Algorithm(s)

Algorithms were not developed from criteria guidelines.

Scope

Disease/Condition(s)

Hematuria

- Nontraumatic (isolated nonpainful, painful)
- Traumatic (renal trauma with gross or microscopic hematuria)

Guideline Category

Diagnosis

Evaluation

Clinical Specialty

Emergency Medicine

Family Practice

Nephrology

Pediatrics

Radiology

Surgery

Urology

Intended Users

Health Plans

Hospitals

Managed Care Organizations

Physicians

Utilization Management

Guideline Objective(s)

To evaluate the appropriateness of initial radiologic examinations for pediatric patients with hematuria

Target Population

Children with hematuria

Interventions and Practices Considered

1. Ultrasound (US) kidneys and bladder
2. X-ray
    - Voiding cystourethrography
    - Abdomen and pelvis
    - Intravenous urography
    - Retrograde urethrography
3. Computed tomography (CT) abdomen and pelvis
    - Without contrast
    - With contrast
    - Without and with contrast
4. CT pelvis with bladder contrast (CT cystography)
5. Magnetic resonance imaging (MRI) abdomen and pelvis
    - Without and with contrast
    - Without contrast
6. Arteriography kidneys

Major Outcomes Considered

Methodology

Methods Used to Collect/Select the Evidence

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Literature Search Procedure

The Medline literature search is based on keywords provided by the topic author. The two general classes of keywords are those related to the condition (e.g., ankle pain, fever) and those that describe the diagnostic or therapeutic intervention of interest (e.g., mammography, MRI).

The search terms and parameters are manipulated to produce the most relevant, current evidence to address the American College of Radiology Appropriateness Criteria (ACR AC) topic being reviewed or developed. Combining the clinical conditions and diagnostic modalities or therapeutic procedures narrows the search to be relevant to the topic. Exploding the term "diagnostic imaging" captures relevant results for diagnostic topics.

The following criteria/limits are used in the searches:

1. Articles that have abstracts available and are concerned with humans.
2. Restrict the search to the year prior to the last topic update or in some cases the author of the topic may specify which year range to use in the search. For new topics, the year range is restricted to the last 5 years unless the topic author provides other instructions.
3. May restrict the search to Adults only or Pediatrics only.
4. Articles consisting of only summaries or case reports are often excluded from final results.

The search strategy may be revised to improve the output as needed.

Number of Source Documents

The total number of source documents identified as the result of the literature search is not known.

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Strength of Evidence Key

Category 1 - The conclusions of the study are valid and strongly supported by study design, analysis, and results.

Category 2 - The conclusions of the study are likely valid, but study design does not permit certainty.

Category 3 - The conclusions of the study may be valid, but the evidence supporting the conclusions is inconclusive or equivocal.

Category 4 - The conclusions of the study may not be valid because the evidence may not be reliable given the study design or analysis.

Methods Used to Analyze the Evidence

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

The topic author drafts or revises the narrative text summarizing the evidence found in the literature. American College of Radiology (ACR) staff draft an evidence table based on the analysis of the selected literature. These tables rate the strength of the evidence for all articles included in the narrative text.

The expert panel reviews the narrative text, evidence table, and the supporting literature for each of the topic-variant combinations and assigns an appropriateness rating for each procedure listed in the table. Each individual panel member forms his/her own opinion based on his/her interpretation of the available evidence.

More information about the evidence table development process can be found in the ACR Appropriateness Criteria® Evidence Table Development document (see the "Availability of Companion Documents" field).

Methods Used to Formulate the Recommendations

Expert Consensus (Delphi)

Description of Methods Used to Formulate the Recommendations

Modified Delphi Technique

The appropriateness ratings for each of the procedures included in the Appropriateness Criteria topics are determined using a modified Delphi methodology. A series of surveys are conducted to elicit each panelist's expert interpretation of the evidence, based on the available data, regarding the appropriateness of an imaging or therapeutic procedure for a specific clinical scenario. American College of Radiology (ACR) staff distributes surveys to the panelists along with the evidence table and narrative. Each panelist interprets the available evidence and rates each procedure. The surveys are completed by panelists without consulting other panelists. The ratings are a scale between 1 and 9, which is further divided into three categories: 1, 2, or 3 is defined as "usually not appropriate"; 4, 5, or 6 is defined as "may be appropriate"; and 7, 8, or 9 is defined as "usually appropriate." Each panel member assigns one rating for each procedure per survey round. The surveys are collected and the results are tabulated, de-identified and redistributed after each round. A maximum of three rounds are conducted. The modified Delphi technique enables each panelist to express individual interpretations of the evidence and his or her expert opinion without excessive bias from fellow panelists in a simple, standardized and economical process.

Consensus among the panel members must be achieved to determine the final rating for each procedure. Consensus is defined as eighty percent (80%) agreement within a rating category. The final rating is determined by the median of all the ratings once consensus has been reached. Up to three rating rounds are conducted to achieve consensus.

If consensus is not reached, the panel is convened by conference call. The strengths and weaknesses of each imaging procedure that has not reached consensus are discussed and a final rating is proposed. If the panelists on the call agree, the rating is accepted as the panel's consensus. The document is circulated to all the panelists to make the final determination. If consensus cannot be reached on the call or when the document is circulated, "No consensus" appears in the rating column and the reasons for this decision are added to the comment sections.

Rating Scheme for the Strength of the Recommendations

Not applicable

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

Internal Peer Review

Description of Method of Guideline Validation

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The recommendations are based on analysis of the current literature and expert panel consensus.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Selection of appropriate radiologic imaging procedures for evaluation of pediatric patients with hematuria

Potential Harms

Computed tomography (CT) exposes children to ionizing radiation.

Relative Radiation Level (RRL)

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults. Additional information regarding radiation dose assessment for imaging examinations can be found in the American College of Radiology (ACR) Appropriateness Criteria® Radiation Dose Assessment Introduction document (see the "Availability of Companion Documents" field).

Qualifying Statements

Qualifying Statements

The American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

Staying Healthy

IOM Domain

Effectiveness

Identifying Information and Availability

Bibliographic Source(s)

Dillman JR, Coley BD, Karmazyn B, Binkovitz LA, Dempsey ME, Dory CE, Garber M, Hayes LL, Meyer JS, Milla SS, Paidas C, Raske ME, Rigsby CK, Strouse PJ, Wootton-Gorges SL, Expert Panel on Pediatric Imaging. ACR Appropriateness CriteriaÂ® hematuria -- child. [online publication]. Reston (VA): American College of Radiology (ACR); 2012. 9 p. [79 references]

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

1999 (revised 2012)

Guideline Developer(s)

American College of Radiology - Medical Specialty Society

Source(s) of Funding

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

Guideline Committee

Committee on Appropriateness Criteria, Expert Panel on Pediatric Imaging

Composition of Group That Authored the Guideline

Panel Members: Jonathan R. Dillman, MD (*Principal Author*); Brian D. Coley, MD (*Panel Chair*); Boaz Karmazyn, MD (*Panel Vice-chair*); Larry A. Binkovitz, MD; Molly E. Dempsey, MD; Christopher E. Dory, MD; Matthew Garber, MD; Laura L. Hayes, MD; James S. Meyer, MD; Sarah S. Milla, MD; Charles Paidas, MD; Molly E. Raske, MD; Cynthia K. Rigsby, MD; Peter J. Strouse, MD; Sandra L. Wootton-Gorges, MD

Financial Disclosures/Conflicts of Interest

Not stated

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Coley BD, Gunderman R, Bulas D, Fordham L, Meyer JS, Karmazyn BK, Podberesky DJ, Prince JS, Paidas C, Rodriguez W, Expert Panel on Pediatric Imaging. ACR Appropriateness Criteria® hematuria - child. [online publication]. Reston (VA): American College of Radiology (ACR); 2009. 7 p.

Guideline Availability

Electronic copies: Available from the American College of Radiology (ACR) Web site.

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

Availability of Companion Documents

The following are available:

- ACR Appropriateness Criteria®. Overview. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.
- ACR Appropriateness Criteria®. Literature search process. Reston (VA): American College of Radiology; 1 p. Electronic copies: Available in PDF from the ACR Web site.
- ACR Appropriateness Criteria®. Evidence table development – diagnostic studies. Reston (VA): American College of Radiology; 2013 Nov. 3 p. Electronic copies: Available in PDF from the ACR Web site.
- ACR Appropriateness Criteria®. Radiation dose assessment introduction. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in PDF from the ACR Web site.
- ACR Appropriateness Criteria®. Procedure information. Reston (VA): American College of Radiology; 1 p. Electronic copies: Available in PDF from the ACR Web site.
- ACR Appropriateness Criteria® hematuria — child. Evidence table. Reston (VA): American College of Radiology; 2012. 21 p. Electronic copies: Available in PDF from the ACR Web site.

Patient Resources

None available

NGC Status

This NGC summary was completed by ECRI Institute on May 15, 2007. This summary was updated by ECRI Institute on May 24, 2010 and on May 9, 2013.

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